REMARKS

In response to the Office Action mailed September 28, 2007, Applicants respectfully request reconsideration. Claims 1-42 were previously pending in this application, with claims 9-26 and 31-36 having been withdrawn from consideration. By this amendment, Applicants are canceling claims 3, 7 and 8 without prejudice or disclaimer. Claims 1, 4, 27, 29, 30 and 37 have been amended herein. New dependent claims 43-45 have been added. As a result, claims 1, 2, 4-6, 27-30 and 37-45 are pending for examination with claims 1, 27 and 37 being independent. No new matter has been added.

Summary of Examiner Interview

Applicants' representatives Melissa Beede and Rob Jensen appreciate the courtesies extended by Examiner Nguyen during the telephone interview of December 13, 2007. The substance of the interview is summarized herein.

Applicants' representatives requested the telephone interview to discuss proposed claim amendments, a copy of which is attached to this response. During the interview, the virtual protocol interlayer described on pages 16 and 17 of Applicants' specification was discussed. The Saijonmaa reference's description of layer 2.5 was also discussed. Although no agreement was reached with respect to particular claim language, it was agreed that Applicants' representatives would amend the independent claims to recite a virtual protocol interlayer. Examiner Nguyen indicated that he would review the claim amendments and contact Applicants' representatives if he has questions or comments. Applicants' representatives thank the Examiner for this offer.

Rejections Under 35 U.S.C. §102

The Office Action rejected claims 1, 7, 8, and 27-30 under 35 U.S.C. 102(e) as allegedly being anticipated by Haas et al., U.S. Published Patent Application No. 2004/0025018. Applicants respectfully request reconsideration.

Haas describes secure communication techniques for mobile ad-hoc networks. A secure route protocol is used which implements security mechanisms within the operation of the network layer (¶25). Hass states that malicious nodes in the network can be foiled from

disrupting the communications of other nodes (¶25). The source of a route is notified in the event of path breakage using a route error packet (¶¶ 59 and 92-97). The quality of various routes is evaluated, and compromised routes are deemed unusable (¶42). The rating of a route is then updated (¶97).

Saijonmaa describes a communications system in which communications can take place over a cellular network or an ad-hoc network. For ad-hoc communications, layer 2.5 may be used to extend the network layer performance (¶42). Saijonmaa does not specify how a route through an ad-hoc network is chosen, however, the creation of logical connections appears to be performed at the application layer (¶37).

Independent Claim 1

Claim 1 as amended recites, *inter alia*, a mesh connectivity layer module adapted to perform routing based on link quality, wherein the mesh connectivity layer module operates within a virtual protocol interlayer that is interposed between a network layer and a link layer of a network protocol stack, wherein the virtual protocol interlayer operates according to virtual addresses that are distinct from associated network layer addresses and link layer addresses, and wherein the mesh connectivity layer module is adapted to perform routing using the virtual addresses.

Neither Hass nor Saijonmaa teaches or suggests a mesh connectivity layer module that operates within a virtual protocol interlayer that is interposed between a network layer and a link layer of a network protocol stack. Hass and Saijonmaa further do not teach or suggest a mesh connectivity layer module that is adapted to perform routing using virtual addresses. Rather, Hass describes security techniques that are implemented within the network layer. Saijonmaa appears to describe the formation of logical connections at the application layer, and does not specify how a route is chosen through an ad-hoc network.

In view of the foregoing, claim 1 patentably distinguishes over Hass and Saijonmaa. Accordingly, withdrawal of the rejection of claim 1 is respectfully requested. Claims 2, 4-6 and 43 depend from claim 1 and are therefore patentable for at least the same reasons.

Independent Claim 27

Claim 27 recites, *inter alia*, a routing and route maintenance method for routing protocol, the method comprising: performing routing using a mesh connectivity layer module based on link quality; operating the mesh connectivity layer module within a virtual protocol interlayer that is interposed between a network layer and a link layer of a network protocol stack; and operating the virtual protocol interlayer according to virtual addresses that are distinct from associated network layer addresses and link layer addresses; whereby the routing is performed using the virtual addresses. For reasons similar to those discussed in connection with claim 1, neither Hass nor Saijonmaa teaches or suggests operating a mesh connectivity layer module within a virtual protocol interlayer. Furthermore, neither Hass nor Saijonmaa teaches or suggests that routing is performed using virtual addresses.

In view of the foregoing, claim 27 patentably distinguishes over Hass and Saijonmaa. Accordingly, withdrawal of the rejection of claim 27 is respectfully requested. Claims 28-30 and 44 depend from claim 27 and are therefore patentable for at least the same reasons.

Independent Claim 37

Claim 37 recites, *inter alia*, a method for routing and maintaining link quality metrics in accordance with a source routing protocol, the method comprising: performing routing using a mesh connectivity layer module based on link quality; operating the mesh connectivity layer module within a virtual protocol interlayer that is interposed between a network layer and a link layer of a network protocol stack; and operating the virtual protocol interlayer according to virtual addresses that are distinct from associated network layer addresses and link layer addresses; whereby the routing is performed using the virtual addresses. For reasons similar to those discussed in connection with claim 1, neither Hass nor Saijonmaa teaches or suggests operating a mesh connectivity layer module within a virtual protocol interlayer. Furthermore, neither Hass nor Saijonmaa teaches or suggests that routing is performed using virtual addresses.

In view of the foregoing, claim 37 patentably distinguishes over Hass and Saijonmaa. Accordingly, withdrawal of the rejection of claim 37 is respectfully requested. Claims 38-42 and 45 depend from claim 37 and are therefore patentable for at least the same reasons.

CONCLUSION

A Notice of Allowance is respectfully requested. The Examiner is requested to call the undersigned at the telephone number listed below if this communication does not place the case in condition for allowance.

If this response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicant hereby requests any necessary extension of time. If there is a fee occasioned by this response, including an extension fee, that is not covered by an enclosed check, please charge any deficiency to Deposit Account No. 23/2825.

Dated: December 21, 2007

Respectfully submitted,

By: /Robert A. Jensen/

Robert A. Jensen
Registration No. 61,146
Wolf, Greenfield & Sacks, P.C.
600 Atlantic Avenue
Boston, Massachusetts 02210-2206
Telephone: (617) 646-8000

Proposed Claim Amendments 10/784,687

Below are proposed claim amendment for discussion purposes during the interview scheduled for Thursday, December 13th at 2PM.

1. (Currently Amended) A system for [[source]] routing in an ad hoc network, the system comprising:

a route discovery mechanism that propagates link quality information;

a route maintenance mechanism that detects a transmission failure and determines whether a link quality metric for a link should be penalized;

a link quality metric maintenance mechanism; and

a mechanism for selecting ~~calculating~~ routes based on link quality metrics;

wherein the routing is performed below a network layer of a network protocol stack.

2. (Original) The system of claim 1 wherein the link quality metric maintenance mechanism comprises:

a reactive metric maintenance mechanism that maintains metrics for links that a node is actively using to route packets; and

a proactive metric maintenance mechanism that maintains metrics of all links.

3. (Original) The system of claim 1 wherein the system resides in a virtual protocol interlayer.

4. (Currently Amended) The system of claim 3 wherein the virtual protocol interlayer comprises layer 2.5 of [[a]] the network protocol stack.

5. (Original) The system of claim 1 wherein the system exposes a virtual Ethernet network adapter to higher layers of a network protocol stack.

6. (Original) The system of claim 5 wherein the system demultiplexes a plurality of physical network adapters.

7. (Original) The system of claim 1 wherein the system resides in a data link layer of a network protocol stack.

8. (Canceled)

9. (Withdrawn) A system for link-state source routing in an ad hoc network, the system comprising: a send buffer that holds packets while route discovery is performed; a maintenance buffer that is used for route maintenance; a request table that suppresses duplicate route discovery requests; and at least one link quality metric module that determines quality of links to neighboring nodes.

10. (Withdrawn) The system of claim 9, further comprising a link cache.

11. (Withdrawn) The system of claim 9, further comprising a route cache that stores link quality metric information.

12. (Withdrawn) The system of claim 9 wherein the at least one link quality metric module uses a probing technique.

13. (Withdrawn) The system of claim 12 wherein the at least one link quality metric module comprises one or more of a per-hop round-trip time metric module, a per-hop packet pair delay metric module, and an expected transmission count metric module.

14. (Withdrawn) The system of claim 9 wherein the at least one link quality metric module determines quality of links based on received signal strength information.

15. (Withdrawn) The system of claim 9 wherein the at least one link quality metric module determines quality of links based on a sender's IEEE 802.11 retransmission counts.

16. (Withdrawn) In a multi-hop ad hoc network, a method for discovery of a route from a first node to a target node, the method comprising: broadcasting, by the first node, a route

request message; receiving, by a neighboring node, the route request; appending, by the neighboring node, an address of the neighboring node to a path listed in the route request, and adding a link quality measurement; rebroadcasting, by the neighboring node, the route request; receiving, by the target node, the route request; and sending, by the target node, a route reply message to the first node, wherein the route reply includes a complete list of link quality measurements for links comprising the route from the first node to the target node.

17. (Withdrawn) The method of claim 16 wherein the sending the route reply to the first node is by way of an independently-discovered source route from the target node to the first node.

18. (Withdrawn) The method of claim 16 wherein the link quality measurement is based on a probing technique.

19. (Withdrawn) The method of claim 18 wherein the link quality measurement is based on one of a per-hop round-trip time metric, a per-hop packet pair delay metric, and an expected transmission count metric.

20. (Withdrawn) The method of claim 16 wherein the link quality measurement is based on received signal strength information.

21. (Withdrawn) The method of claim 16 wherein the link quality measurement is based on a sender's IEEE 802.11 retransmission counts.

22. (Withdrawn) In a multi-hop ad hoc network, a method for forwarding a data packet from a source node to a destination node by way of a source route listed in the data packet, the method comprising: by a forwarding node, modifying the source route with one or more updated link quality measurements; and by the destination node, updating the destination node's link cache with link quality information for the source route.

23. (Withdrawn) The method of claim 22 wherein the one or more updated link quality measurements are based on a probing technique.

24. (Withdrawn) The method of claim 23 wherein the one or more updated link quality measurements are based on one of a per-hop round-trip time metric, a per-hop packet pair delay metric, and an expected transmission count metric.

25. (Withdrawn) The method of claim 22 wherein the one or more updated link quality measurements are based on received signal strength information.

26. (Withdrawn) The method of claim 22 wherein the one or more updated link quality measurements are based on a sender's IEEE 802.11 retransmission counts.

27. (Currently Amended) In a multi-hop ad hoc network, a route maintenance method for a [[source]] routing protocol, the method comprising:

determining, by a forwarding node sending a packet to a neighboring node over a next link in a source route for the packet, whether the next link fails to carry the packet; [[and]]

if the next link fails to carry the packet, penalizing a link quality metric associated with the next link; and

performing routing according to the routing protocol below a network layer of a network protocol stack.

28. (Original) The method of claim 27, further comprising sending a route error message carrying the penalized link quality metric to a source of the packet.

29. (Original) The method of claim 27 wherein the penalizing the link quality metric comprises increasing a value for the link quality metric by a percentage.

30. (Original) The method of claim 27 wherein the determining whether the link fails to carry the packet comprises detecting that an explicit acknowledgement message has not been received from the neighboring node within a time interval.

31. (Withdrawn) A computer-implemented method for sending a packet by a node in a multi-hop ad hoc network in accordance with a source routing protocol, the method comprising: if the packet is not a unicast packet, using a route request message including link quality information to broadcast the packet; if the packet is a unicast packet and a source route for the packet is stored in a link cache, placing the packet in a maintenance buffer; adding the source route, including link quality information, to the packet; and sending the packet to a next hop in the source route; if the packet is a unicast packet and the source route is not stored in the link cache, placing the packet in a send buffer; and sending a route request to discover the source route.

32. (Withdrawn) The method of claim 31, further comprising: adding a layer 2.5 header to the packet.

33. (Withdrawn) The method of claim 31 wherein sending the packet to the next hop comprises: if a layer 2 address for the next hop is stored in a neighbor cache, sending the packet to the layer 2 address; and otherwise, sending the packet by way of a layer 2 broadcast.

34. (Withdrawn) A computer-readable medium storing computer-executable instructions for performing the method of claim 31.

35. (Withdrawn) A computer-implemented method for receiving a packet by a node in a multi-hop ad hoc network in accordance with a source routing protocol, the method comprising: updating a link cache with link quality information contained in the packet; if the packet is a route request, and the node is a target of the route request, sending a route reply, including link quality information; if the packet is a route request, and the node is not the target, determining whether the route request is a duplicate of a request in a request table; if the route request is a duplicate, suppressing the route request; if the route request is not a duplicate, adding the route request to the request table; adding link quality information to the route request; and rebroadcasting the route request; if the packet is a source routed packet, and the node is not a

final destination of the packet, updating the source route with link quality information; and using a maintenance buffer to forward the packet.

36. (Withdrawn) A computer-readable medium storing computer-executable instructions for performing the method of claim 35.

37. (Currently Amended) In a multi-hop ad hoc network, a method for maintaining link quality metrics in accordance with a [[source]] routing protocol, the method comprising:

reactively maintaining link quality metrics for a source route of a packet; [[and]]

proactively maintaining link quality metrics for all links; and

performing routing according to the routing protocol below a network layer of a network protocol stack.

38. (Original) The method of claim 37 wherein the reactively maintaining link quality metrics comprises:

by a forwarding node, updating the source route with a current link quality metric for a next link in the source route; and

by a destination node, sending a gratuitous route reply message to a source node of the packet, wherein the gratuitous route reply contains link quality metrics for the source route.

39. (Original) The method of claim 38 wherein the sending the gratuitous route reply message comprises: delaying the sending for a time interval while the destination node waits for an opportunity to piggyback the gratuitous route reply; and while delaying the sending, updating the link quality metrics for the source route when an additional packet arrives from the source node.

40. (Original) The method of claim 37 wherein the proactively maintaining link quality metrics comprises: by each node in the network, periodically broadcasting a link information message that carries current link quality metrics for each link from the node.

41. (Original) The method of claim 40 wherein the broadcasting the link information message comprises piggybacking the link information message on a route request.

42. (Original) The method of claim 40 wherein the broadcasting the link information message comprises generating a dummy route request to carry the link information message.

43. (New) The system of claim 1, wherein the routing is performed above a physical layer of the network protocol stack.